Vacant Benthic Habitats: Where Have All the Sea Pens Gone?

Michael A. Kyte
Golder Associates Inc.

Abstract

In 1968, Charles Birkeland documented an almost continuous band of the sea pen *Ptilosarcus gurneyi* around Central Puget Sound. This sea pen was described as a "key industry" species supporting a food web of eight predators. Further examples of dense beds of sea pens were described from additional locations in Puget Sound through the 1970s and 1980s. However, in recent years, once prolific sea pens have become scarce and have disappeared from areas once densely populated. With the sea pens have gone their predators. This disappearance of a once prolific assemblage has left vacant large areas of subtidal sand bottom benthic habitat in Central Puget Sound. With the decline of rockfish (*Sebastes* sp.) and other bottom fish, many benthic habitats have been left vacant. This study documents another vacant habitat.

Extended Abstract

In 1968 and 1974, Charles Birkeland documented an almost continuous band of the seapen *Ptilosarcus gurneyi* around Central Puget Sound (Birkeland, 1968, 1974). This seapen was described as a "key – industry species" supporting a food web of eight predators listed below:

- *Hippasteria spinosa* (seastar)
- *Mediaster aequalis* (seastar)
- *Crossaster papposus* (seastar)
- *Dermasterias imbricata* (seastar)
- *Hermissenda crassicornis* (nudibranch)
- *Armina californica (*nudibranch*)*
- *Tritonia festiva* (nudibranch)

A top predator, the seastar *Solaster dawsoni*, feeds on several of the predators of *Ptilosarcus* (Figure 1). This food web was illustrated by Birkeland as follows:

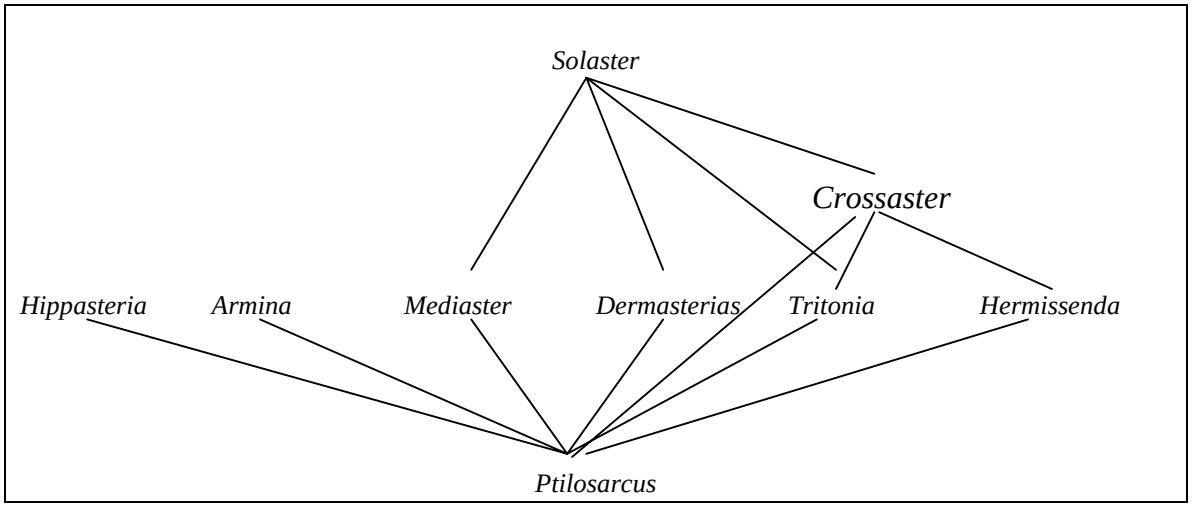

Figure 1 Trophic Relations Between Ptilosarcus and Its Predators (from Birkeland 1974)

The fact that this food web is supported by *Ptilosarcus* as a key-industry species is shown by Birkeland's statement "*Ptilosarcus gurneyi* is a key-industry species in that it provides a major source of food for a variety of predators. In its absence, three of these predators (*Hippasteria, Armina,* and *Tritonia festiva*) would be unable to exist without changing their diets" (Birkeland 1974:229).

Along the east side of central Puget Sound, Birkeland documented the presence and life history of *Ptilosarcus* at 7 sites listed below:

- Richmond Beach
- Carkeek Park
- Golden Gardens
- Alki Point (3 locations)
- Brace Point

I documented through incidental observations further examples of dense beds of sea pens with their predators in the following locations along the eastern edge of Central Puget Sound through the 1970s and 1980s:

- Des Moines (Kyte 1985)
- Seahurst Park
- Saltwater State Park
- Edmonds

In recent years, once prolific sea pens have nearly disappeared from all the areas in which dense populations were documented. I have documented this absence by diving in Birkeland's (1968) study areas and at Des Moines and found a nearly complete absence of seapens (Table 1).

Table 1. Observed Seapen Abundance (per square meter)

Location/Year	1974 (Birkeland, 1968, 1974)	1985 (Kyte, 1985)	1996-2000 (Kyte, 1997, 1999)
Golden Gardens, Alki Pt. (south), Brace Pt.	22	Golden Gardens – absent	< l (juvenile only)
Des Moines	Not examined	10 to 20	0 (see text)

In addition, where seapens are still present in Birkeland's study areas at Alki Point (3 areas), their population density is not only substantially reduced to less than 1 per square meter, but the existing population consists of only juvenile individuals (approximately 1-year old). The large, adult seapens observed by Birkeland, other divers, and me in the 1960s and 1970s are generally missing. Indeed, I found the dense populations recorded by Birkeland at Richmond Beach, Carkeek Park, and Brace Point were entirely missing in 1999.

With the sea pens have gone their predators. During numerous dives during the 1990s, both the seastars and nudibranchs were found missing or relatively rare at nearly all the locations where Birkeland and I found them in abundance in the 1960s and 1970s (Table 2). In other words, Birkeland could not have studied seapens in the former study areas for his M.Sc. or Ph.D. today.

Table 2. Predator Abundance at Seapen Study Sites
(reported by Birkeland (1974)/observed by Kyte 1999 – 2000)

	Abundance per 100 square meters					
Location (all depths combined at each location)	Hippasteria	Mediaster	Crossaster	Dermasterias	Armina	Tritonia
Golden Gardens	3.6/<1	6.2/<1	0.8/P (R)	0.1/P (R)	P/P (R)	P/A
Alki South	15.2/A	0.45/P (R)	0.45/A	0.4/A	P/A	P/A
Alki Plateau	6.8/A	2.0/<1	1.2/A	0.6/P (R)	P/A	P/A
Brace Point	A/A	4.4/<1	0.5/A	P/P (R)	11/A	0.3/A
Richmond Beach	A/A	4.7/<1	1.3/A	P/P (R)	NR/A	NR/A

P = present, A = absent, R = rare, NR = not reported

Seapens are not a commercially important species, but are of obvious ecological importance in the Puget Sound benthic ecosystem. Disappearance of their populations with their predators has removed significant biomass and pelagic larval food resources for salmonids, forage fish, and many other components of the area's food webs.

This disappearance of a once prolific assemblage has left vacant large areas of subtidal sand bottom benthic habitat in Central Puget Sound. This phenomenon of "vacant habitats" has also been seen by Washington Department of Fish and Wildlife during their rockfish VAT (video acoustic technique) surveys (Palsson 2000). Apparently the decline of rockfish (*Sebastes* sp.) throughout Puget Sound and the San Juan Islands has left suitable benthic habitats vacant.

Unlike the rockfish, where overfishing has been a clear cause of the population decline, there is no "smoking gun" for the decline of seapens. As showed by Birkeland, the populations of *Ptilosarcus* and its predators were dynamically balanced. For instance, *Hippasteria* ranged into shallower waters when *Ptilosarcus* populations in greater depths were depleted. As the shallower seapen beds were reduced by predation, *Hippasteria* retreated from the nearshore areas to prey upon the deeper seapen populations that had recovered. Thus, it is unlikely that the present wide spread absence is due to predation.
A variety of other environmental factors could be associated with this situation including the following:

- Warmer sea water temperatures due to the Pacific Decadal Oscillation and El Niño
- Decline in plankton populations due to natural and anthropogenic factors
- Collecting by researchers to support laboratory populations of predatory nudibranchs

References

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